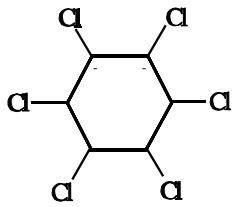
HEXACHLOROCYCLOHEXANES

Lindane is a federal hazardous air pollutant and was identified as a toxic air contaminant in April 1993 under AB 2728.

CAS Registry Number: 608-73-1

Molecular Formula: $C_6H_6Cl_6$



Hexachlorocyclohexanes (HCH) include several isomers of the pesticide benzene hexachloride. The name lindane usually refers to the gamma-isomer of 1,2,3,4,5,6-hexachlorocyclohexane, but it is used sometimes to mean the eight stereoisomers of this compound (see summary sheet on lindane page 611). Lindane is found as white or yellowish powder or flakes. It has a persistent musty odor and its melting point may vary with isomeric composition. It is soluble in ethyl alcohol, chloroform, and ethyl ether; and insoluble in water (HSDB, 1993).

Physical Properties of Hexachlorocyclohexanes

Synonyms:	1,2,3,4,5,6-hexachlorocyclohexane; benzene hexachloride; BHC; HCCH; HCH; TBH; lindane
Molecular Weight:	290.8
Melting Point:	113 °C
Density/Specific Gravity:	1.87 at 20 °C (water = 1)
Vapor Pressure:	0.5 mm Hg at 60 °C

(HSDB, 1993; Sax, 1987)

SOURCES AND EMISSIONS

A. Sources

The primary stationary sources that have reported emissions of HCH in California are manufacturers of household furniture, automotive repair shops, and manufacturers of toys and sporting goods (ARB, 1997b).

Hexachlorocyclohexane (BHC) was registered for use as a pesticide, however as of January 17, 1983, it is no longer registered for pesticidal use in California (DPR, 1996).

B. Emissions

The total emissions of HCH, including lindane, from stationary sources in California are estimated to be at least 890 pounds per year, based on data reported under the Air Toxics "Hot Spots" Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

No information about the natural occurrence of HCH was found in the readily-available literature.

AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of HCH. However, the United States Environmental Protection Agency (U.S. EPA) compiled data from a rural location in Texas from 1979-80. This data reported a mean ambient concentration for lindane of
0.23 nanograms per cubic meter (ng/m^3) with a range of 0.01 to 1.6 ng/m^3 (U.S. EPA, 1993a).

INDOOR SOURCES AND CONCENTRATIONS

No information about the indoor sources and concentrations of the class of HCH was found in the readily-available literature. See the summary sheet on lindane page 611 for information on its indoor concentrations.

ATMOSPHERIC PERSISTENCE

HCH exists in the atmosphere in the gas phase. The dominant chemical loss process for the HCH is by reaction with the hydroxyl (OH) radical. Based upon the rate constant calculated for this OH radical reaction (Kwok and Atkinson, 1995), the atmospheric half-life and lifetime of HCH due to reaction with the OH radical is estimated to be about 17 days and 25 days, respectively (Atkinson, 1995). Air to water exchange to (and from) the oceans is also important for the HCH [of which lindane is an isomer] (Hale and Bidleman, 1995).

AB 2588 RISK ASSESSMENT INFORMATION

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program. Of the risk assessments reviewed as of April 1996, HCH contributed to the total cancer risk in 1 of the approximately 550 risk assessments reporting a total cancer risk equal to or greater than 1 in 1 million (OEHHA, 1996a).

HEALTH EFFECTS

The "-, $-, (- (lindane), and *-HCH isomers are toxicologically significant. Technical-grade HCH may contain multiple isomers. Because of its use as an insecticide, potential routes of HCH exposure to humans are inhalation, ingestion, or dermal contact.

Non-Cancer: Exposure to HCH, particularly from its use as a pesticide, has resulted in toxic effects in humans including irritation of the lungs, heart and blood disorders, headache, convulsions, and hormonal changes. Death has resulted from exposure to high levels of HCH. Studies exposing animals to HCHs in feed indicate kidney disease and injury to the ovary and testes can result from exposure to $-HCH or lindane, and liver disease can result from exposure to "-, $-, or technical-grade HCH. Increased susceptibility to disease has been observed in animals fed lindane. Birth defects have also been reported in animals orally exposed to lindane during pregnancy (Sittig, 1991).

A chronic non-cancer Reference Exposure Level (REL) of 1 microgram per cubic meter is listed for lindane in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoints considered for chronic toxicity are liver, gastrointestinal tract, and kidney toxicity in rats (CAPCOA, 1993). The Reference Concentration (RfC) for lindane is under review by the
U.S. EPA. The U.S. EPA has established an oral Reference Dose (RfD) of 3×10^{-4} milligrams per kilogram per day based on liver and kidney effects in rats. The U.S. EPA estimates that consumption of this dose or less, over a lifetime, would not likely result in the occurrence of chronic, non-cancer effects (U.S. EPA, 1995a).

Cancer: Technical-grade HCH, "-HCH, and $-HCH have each been shown to cause liver tumors in mice exposed to the compound in their feed. The U.S. EPA has classified technical-grade and "-HCH as Group B2: Probable human carcinogens; $-HCH as Group C: Possible human carcinogen; and *- and ,-HCH as Group D: Not classifiable based on inadequate evidence in humans and animals (U.S. EPA, 1995a). The International Agency for Research on Cancer has classified technical-grade HCH, "-, $-, and (-HCH as Group 2B: Possible human carcinogens (IARC, 1987a).

The State of California has determined under Proposition 65 that lindane and other HCH isomers, and technical-grade HCH are carcinogens (CCR, 1997). The inhalation potency factor that has been used as a basis for regulatory action in California is 1.1×10^{-3} (microgram per cubic meter)$^{-1}$ (OEHHA, 1994). In other words, the potential excess cancer risk for a person exposed over a lifetime to 1 microgram of HCH per cubic meter of air is estimated to be no greater than 1,100 in 1 million. The oral potency factor that has been used as a basis for regulatory action in California is 4.0 (milligram per kilogram per day)$^{-1}$ (OEHHA, 1994).